UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

AD-A215 319

DTIC ELECTE DEC 21 1989 D B

1a. REPORT SECURITY CLASSIFICATION	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 89-1306
6a. NAME OF PERFORMING ORGANIZATION: University of North Carolina — 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION: Air Force Office of Scientific Research
6c. ADDRESS (City, State, and ZIP Code): 440 W. Franklin St, Bldg 454H, Chapel Hill, NC 27514	7b. ADDRESS (City, State, and ZIP Code): Building 410, Bolling AFB, DC 20332-6448
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: AFOSR — 8b. OFFICE SYMBOL (If applicable): NM	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: AFOSR-85-0200
8c. ADDRESS (City, State, and ZIP Code): Building 410, Bolling AFB, DC 20332-6448	10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
61102F	2304	A4	

11. TITLE (Include Security Classification): Dynamical Systems

12. PERSONAL AUTHOR(S): Dr. Sheldon E. Newhouse

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 1 Jul 85 TO 31 Dec 87		

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

We have developed a structure theory for real analytic diffeomorphisms of compact surfaces very similar to the well known structure theory of Axiom A diffeomorphisms. This theory has strong implications for the structure of systems with two degrees of freedom. We have shown that there is an at most countable collection of closed invariant sets $_1$, $_2$,... with the following properties: 1. Any closed invariant set of which has positive topological entropy is a subset of some $_i$. 2. A large subset of $_i$ has a description as a symbolic space on a countable number of symbols. These results are currently being written up. In addition, we have found a relatively simple proof of our previously established result that there are residual subsets A of open sets of diffeomorphisms with the property that each element in A has infinitely many sinks. A slight modification of this proof will

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
Dr. Arje Nachman	(202) 767-4939	NM

DD Form 1473, JUN 86 Previous editions are obsolete. SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

89 12 21 048

appear in some notes of Palis and Takens on bifurcation theory presented at a Colloquium in Brazil in July, 1987. Another result states that many systems with two degrees of freedom have fractal basin boundaries with Hausdorff dimension two (i.e. maximal Hausdorff dimension). This leads to the frequent existence of what we call pseudo-attractors-- closed invariant sets with dense orbits whose basins have maximal dimension. Finally, we have made progress on a numerical procedure to estimate topological entropy in low dimensional smooth dynamical systems.

AFOSR-TR- 89-1306

FINAL TECHNICAL REPORT for AFOSR-85-0200

During the tenure of this grant we have made significant progress on several problems.

We have developed a structure theory for real analytic diffeomorphisms of compact surfaces very similar to the well known structure theory of Axiom A diffeomorphisms. This theory has strong implications for the structure of systems with two degrees of freedom. We have shown that there is an at most countable collection of closed invariant sets $\Lambda_1, \Lambda_2, \ldots$ with the following properties:

1. Any closed invariant set on which f has positive topological entropy is a subset of some Λ_i.

2. A large subset of Λ_i has a description as a symbolic space on a countable number of symbols.

These results are currently being written up.

In addition, we have found a relatively simple proof of our previously established result that there are residual subsets A of open sets of diffeomorphisms with the property that each element in A has infinitely many sinks. A slight modification of this proof will appear in some notes of Palis and Takens on bifurcation theory presented at a Colloquium in Brazil in July, 1987.

Another result states that many systems with two degrees of freedom have fractal basin boundaries with Hausdorff dimension two (i.e. maximal Hausdorff dimension). This leads to the frequent existence of what we call pseudo-attractors—closed invariant sets with dense orbits whose basins have maximal dimension.

Finally, we have made progress on a numerical procedure to estimate topological entropy in low dimensional smooth dynamical systems.

The following papers have resulted in part from the support under this grant.

1. *Continuity Properties of Entropy*, to appear in Annals of Math.

2. *Entropy and Volume*, to appear in Jour. of Ergodic Theory and Dynamical Systems.

3. *On the dimension of fractal basin boundaries*, in preparation.

4. *Computing Topological Entropy*, in preparation.